

IN THE CLAIMS:

Please amend the claims as indicated below.

- 1 1. (withdrawn) A composite electrolyte for use in electrochemical fuel cells, comprising:
 - 2 (i) an inorganic cation exchange material;
 - 3 (ii) a silica-based material; and
 - 4 (iii) a proton conducting polymer-based material, wherein the inorganic cation
 - 5 exchange material comprises about 0.1 wt% to about 99 wt% of the composite
 - 6 electrolyte.
- 1 2. (withdrawn) The composite electrolyte of claim 1, wherein the silica-based material
- 2 comprises about 0.1 wt% to about 70 wt%, and the proton conducting polymer-based
- 3 material comprises about 0.1 wt% to 99.9 wt% of the composite electrolyte.
- 1 3. (withdrawn) The composite electrolyte of claim 1 wherein the inorganic cation exchange
- 2 material is selected from the group consisting of clay, zeolite, hydrous oxide, and inorganic
- 3 salt.
- 1 4. (withdrawn) The composite electrolyte of claim 3, wherein the clay includes an
- 2 aluminosilicate-based exchange material selected from the group consisting of
- 3 montmorillonite, kaolinite, vermiculite, smectite, hectorite, mica, bentonite, nontronite,
- 4 beidellite, volkonskoite, saponite, magadite, kenyaite, zeolite, alumina, rutile.
- 1 5. (withdrawn) The composite material of claim 3, wherein the clay is modified to make it
- 2 more compatible with organic matrices, a clay modification including exfoliation which helps
- 3 to separate platelets of inorganic substance.
- 1 6. (withdrawn) The composite electrolyte of claim 3, wherein the clay includes a modified
- 2 montmorillonite consisting of montmorillonite treated with a modifier material selected from
- 3 a group consisting of aminododecanoic acid, trimethyl stearate ammonium, octadecylamine,
- 4 and methyl dihydroxy hydrogenated tallow ammonium.
- 1 7. (withdrawn) The composite electrolyte of claim 1 wherein the inorganic cation exchange
- 2 material comprises about 0.1 wt% to about 30 wt%, the silica-based material comprises about

3 0.1 wt% to about 30 wt%, and the proton conducting polymer-based material comprises
4 about 40 wt% to 99.9 wt% of the composite electrolyte.

1 8. (withdrawn) The composite electrolyte of claim 1 wherein the proton conducting polymer-
2 based material has a linear, branched, or network morphology.

1 9. (withdrawn) The composite electrolyte of claim 1 wherein the proton conducting polymer-
2 based material includes material selected from the group consisting of
3 acrylonitrile/butadiene/styrene rubber (ABS), styrene butadiene/acrylate/acetate polymer
4 blends, epoxides, and a thermoplastic material.

1 10. (withdrawn) The composite electrolyte of claim 9 wherein the thermoplastic material is
2 selected from a group consisting polypropylene, polycarbonate, polystyrene, polyethylene,
3 polyaryl ethers sulfones, poly aryl ether ketone, and polysulfones.

1 11. (withdrawn) The composite electrolyte of claim 1 wherein the proton conducting
2 polymer-based material has a functional group element selected from a group consisting of
3 sulfonate, phosphate, carbonate, amide, and imide, wherein each such functional group
4 element has proton conducting capabilities.

1 12. (withdrawn) The composite electrolyte of claim 1, further comprising an additive selected
2 from a group consisting of preservative, thixotropy and viscosity control agent, crosslinking
3 agent, conditioner, plasticizer, water control agent, and proton conducting material.

1 13. (withdrawn) The composite electrolyte of claim 1 wherein the inorganic cation exchange
2 material, the silica-based material and the proton conducting polymer-based material
3 comprise 90 wt % or more of the solids content of the composite electrolyte.

1 14. (withdrawn) The composite electrolyte of claim 1 wherein the composite electrolyte when
2 measured in the substantially dried state consists essentially of the inorganic cation exchange
3 material, the silica-based material and the proton conducting polymer-based material.

1 15. (withdrawn) The composite electrolyte of claim 1 wherein the composite electrolyte has a
2 proton conductivity of about 0.05 S/cm or higher

- 1 16. (withdrawn) The composite electrolyte of claim 1 wherein the silica-based material
2 includes materials containing one or more of silica, silicate, and silicate having an organic
3 element.
- 1 17. (withdrawn) The composite electrolyte of claim 1 wherein the silica-based material is
2 either colloidal silica containing discrete spheres of silica or tetraethylorthosilicate.
- 1 18. (withdrawn) An electrochemical fuel cell, comprising:
2 (i) an anode;
3 (ii) a cathode;
4 (iii) a fuel supply to the anode;
5 (iv) an oxidant supply to the cathode; and
6 (v) a composite electrolyte positioned between the anode and cathode and
7 including
8 (a) an inorganic cation material,
9 (b) a silica-based binder, and
10 (c) a polymer-based binder,
11 wherein the inorganic cation exchange material comprises about 0.1 wt% to about 99
12 wt%, of the composite electrolyte.
- 1 19. (withdrawn) The electrochemical fuel cell of claim 18 wherein the silica-based material
2 comprises about 0.1 wt% to about 70 wt%, and the proton conducting polymer-based
3 material comprises about 0.1 wt% to 99.9 wt% of the composite electrolyte.
- 1 20. (withdrawn) The electrochemical fuel cell of claim 18 wherein the inorganic cation
2 exchange material comprises about 0.1 wt% to about 30 wt%, the silica-based material
3 comprises about 0.1 wt% to about 30 wt%, and the proton conducting polymer-based
4 material comprises about 40 wt% to 99.9 wt% of the composite electrolyte.
- 1 21. (withdrawn) The electrochemical fuel cell of claim 18 wherein the inorganic cation
2 exchange material is selected from the group consisting of clay, zeolite, hydrous oxide, and
3 inorganic salt.

- 1 22. (withdrawn) The electrochemical fuel cell of claim 21 wherein the clay includes an
2 aluminosilicate-based exchange material selected from the group consisting of
3 montmorillonite, kaolinite, vermiculite, smectite, hectorite, mica, bentonite, nontronite,
4 beidellite, volkonskoite, saponite, magadite, kenyaite, zeolite, alumina, and rutile.
- 1 23. (withdrawn) The electrochemical fuel cell of claim 21, wherein the clay is modified to
2 make it more compatible with organic matrices, a clay modification including exfoliation
3 which helps to separate platelets of inorganic substance.
- 1 24. (withdrawn) The electrochemical fuel cell of claim 21, wherein the clay includes a
2 modified montmorillonite consisting of montmorillonite treated with a modifier material
3 selected from a group consisting of aminododecanoic acid, trimethyl stearate ammonium,
4 octadecylamine, and methyl dihydroxy hydrogenated tallow ammonium.
- 1 25. (withdrawn) The electrochemical fuel cell of claim 18 wherein the polymer-based
2 material has linear, branched, or network morphology.
- 1 26. (withdrawn) The electrochemical fuel cell of claim 18 wherein the polymer-based
2 material includes material selected from the group consisting of
3 acrylonitrile/butadiene/styrene rubber (ABS), styrene butadiene/acrylate/acetate polymer
4 blends, epoxides, polypropylene, polycarbonate, polystyrene, polyethylene, polyaryl ethers,
5 and polysulfones.
- 1 27. (withdrawn) The electrochemical fuel cell of claim 18 wherein the inorganic cation
2 exchange material, the silica-based material and the polymer-based material comprise 90 wt
3 % or more of the solids content of the composite electrolyte.
- 1 28. (withdrawn) The electrochemical fuel cell of claim 18 wherein the composite electrolyte
2 when measured in the substantially dried state consists essentially of the inorganic cation
3 exchange material, the silica-based material and the polymer-based material.
- 1 29. (withdrawn) The electrochemical fuel cell of claim 18 wherein the composite electrolyte
2 has a proton conductivity of about 0.05 S/cm or higher.

1 30. (original) A method of fabricating a composite electrolyte for use in an
2 electrochemical fuel cell, comprising:

- 3 (i) applying onto a surface of a substrate a viscous liquid composition of (a)
4 an inorganic cation exchange material, (b) silica-based material, (c) a
5 polymer-based material, and (d) a solvent-dispersant;
6 (ii) spreading the viscous liquid composition to form a uniform thickness layer
7 on the substrate; and
8 (iii) allowing the solvent to evaporate from the viscous liquid composition to
9 yield the composite electrolyte,
10 wherein the inorganic cation exchange material comprises about 0.1 wt%
11 to about 99 wt% of the composite electrolyte.

1 31. (original) The method of claim 30, wherein the silica-based material comprises about
2 0.1 wt% to about 70 wt%, and the polymer-based material comprises about 0.1 wt% to
3 99.9 wt% of the composite electrolyte.

1 32. (original) The method of claim 30 wherein step (ii) includes drawing the viscous
2 liquid composition through a doctor blade assembly.

1 33. (original) The method of claim 30 wherein step (iii) includes heating the viscous
2 liquid composition.

1 34. (original) The method of claim 30 wherein the inorganic cation exchange material
2 comprises about 0.1 wt% to about 30 wt%, the silica-based material comprises about 0.1
3 wt% to about 15 wt%, and the polymer-based material comprises about 40 wt% to 99
4 wt% of the composite electrolyte.

1 35. (currently amended) The method of claim [19] 30 wherein the inorganic cation

2 exchange material is selected from the group consisting of clay, zeolite, hydrous oxide,
3 inorganic and salt.

1 36. (original) The method of claim 35 wherein the clay includes an aluminosilicate-based
2 exchange material selected from the group consisting of montmorillonite, kaolinite,
3 vermiculite, smectite, hectorite, mica, bentonite, nontronite, beidellite, volkonskoite,
4 saponite, magadite, kenyaite, zeolite, alumina, and rutile.

1 37. (original) The method of claim 35, wherein the clay is modified to make it more
2 compatible with organic matrices, a clay modification including exfoliation which helps
3 to separate platelets of inorganic substance.

1 38. (original) The method of claim 35, wherein the clay includes a modified
2 montmorillonite consisting of montmorillonite treated with a modifier material selected
3 from a group consisting of aminododecanoic acid, trimethyl stearate ammonium,
4 octadecylamine, and methyl dihydroxy hydrogenated tallow ammonium.

1 39. (original) The method of claim 30 wherein the polymer-based material has a linear,
2 branched, or netted morphology.

1 40. (original) The method of claim 30 wherein the polymer-based material includes one
2 of acrylonitrile/butadiene/styrene rubber (ABS), styrene butadiene/acrylate/acetate
3 polymer blends, epoxides, polypropylene, polycarbonate, polystyrene, polyethylene,
4 polyaryl ethers, and polysulfones.

- 1 41. (original) The method of claim 30 wherein the solvent-dispersant comprises water, N-
2 methyl pyrrolidinone, dimethyl sulfoxide, dimethyl acidimide, and dimethylformamide.
- 1 42. (original) The method of claim 30 wherein the inorganic cation exchange material, the
2 silica-based material and the polymer-based material comprise 90 wt % or more of the solids
3 content of the composite electrolyte.
- 1 43. (original) The method of claim 30 wherein the composite electrolyte when measured in
2 the substantially dried state consists essentially of the inorganic cation exchange material, the
3 silica-based material and the polymer-based material.
- 1 44. (currently amended) The method of claim [19] 30 wherein the composite electrolyte has a
2 proton conductivity of about 0.05 S/cm or higher.
- 1 45. (withdrawn) A method for producing a composite membrane, comprising:
2 (i) grinding a sulfonated polyether ether ketone (SPEEK) and clay mixture and
3 dissolving the mixture in a distilled dimethylformamide (DMF) to form a solution;
4 (ii) heating the solution until it thickens and attains a casting consistency;
5 (iii) degassing the solution in a vacuum oven;
6 (iv) casting the solution into a film on a glass surface using a doctor blade;
7 (v) curing the film; and
8 (vi) peeling the film from the glass.
- 1 46. (withdrawn) The method of claim 45, wherein the dissolving in step (i) is performed by
2 stirring for about 2 hours using a magnetic stir bar.
- 1 47. (withdrawn) The method of claim 45, wherein the solution is stirred while heated, and
2 wherein the DMF evaporates.

1 48. (withdrawn) The method of claim 45, wherein the film is about 60 μm thick.

1 49. (withdrawn) The method of claim 45, wherein the curing includes,

2 (a) annealing the film in a convection oven, and

3 (b) maintaining the film in a vacuum for a predetermined time period at a

4 predetermined temperature.

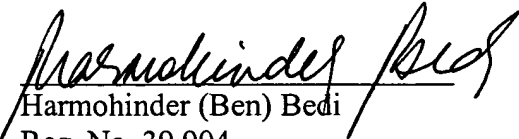
1 50. (withdrawn) The method of claim 45, further comprising:

2 storing the film in ultra-pure water until it is ready for use.

Respectfully submitted,

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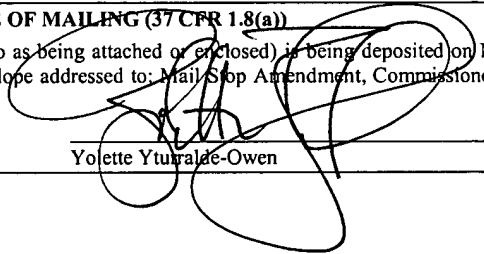

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